

A COMPLETE OVERVIEW ON THE TRADITIONAL USES, PHYTOCONSTITUENTS, PHARMACOLOGICAL USES AND CONSERVATIONAL STRATEGIES OF *Gymnema sylvestre* (Retz) Schult. (ASCLEPIADACEAE)—A RARE AND VALUABLE MEDICINAL PLANT

SANTANU GUPTA

Assistant Professor, Department of Botany, Malda College, Rabindra Avenue, Malda -732101, West Bengal, India

ABSTRACT

Gymnema sylvestre (Retz) Schult. has acquired worldwide attention as the most common anti-diabetic and anti-obesity plant in recent years. The purported miracle herb, *Gymnema* is applied to support the management of diabetes and lower the absorption of sugar in the intestine. A number of companies are involved in the trade of *Gymnema sylvestre* (Retz) Schult., which supply the material either as a whole plant or leaves or leaf extract. But overexploitation and uncontrolled trade along with habitat loss made this plant quite prone to become an endangered species in the near future. So insitu propagation of the plant along with large production of the secondary metabolites is on a high. The present paper provides a suitable overview on the ethnopharmacological, pharmacological and in situ conservational strategies of *Gymnema sylvestre* (Retz) Schult.

KEYWORDS: Phytochemicals, Diabetes, Triterpenoids, Saponins, Micropropagation & Gymnemic acids

Original Article

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INTRODUCTION

For a long time, plants are considered a valuable source of natural products for maintaining human health. Nowadays the use of phytochemicals for pharmaceutical purposes is on a high. According to the World Health organisation, medicinal plants would be the best source of drugs in the near future. Plants formed the basis of traditional medicine in the past, and have given rise to many important drugs that are still in use today. Chakra Samhita has recorded more than 200 vegetable remedies for various ailments. In India, there are more than 7000 species of medicinal plants. (Kuzuku et al 1979). *Gymnema sylvestre* (Retz) Schult., a vulnerable medicinal plant, is a slow growing perennial woody climber found in central and peninsular India possessing roots at nodes. Its leaves are called Gurmar in India is a characteristic sweet taste suppressing agent (Sofowara 1996) The leaves are elliptical in outline with acuminate tips. The upper surface of the leaves are glabrous and lower surface is densely tomentose. It bears flowers which are small axillary and with long pedicels. The calyx is a lobular structure and the petals are light yellow in colour (Naik 1999)

ETHNOMEDICINAL VALUE

Documentation of traditional knowledge of ethnomedicinal use of plants has been considered as a high priority to support the discoveries of drugs benefitting mankind. The tribals of West Bengal hold a tremendous amount of traditional knowledge on the ethno medicinal use of *Gymnema sylvestre* (Retz) Schult (Das & Mondal 2021).

Traditional uses are depicted below

- The Santals of West Bengal used to chew the green leaves of this plant in the morning to keep their urine clear.(Naik 1999)
- They also use their leaves for asthma and bronchitis (Chadwick & Marsh 1994).
- They also use the leaves to treat the bite of a scorpion. According to them, it helps to nullify the toxin released by it.(Jain & Mudgal 1983).
- The root boiled with water is used in the treatment of abdominal enlargement in children. It also reduces the glandular swellings in children.(Mukherjee et al 2006)
- The latex is used in the treatment of ulcers and wounds.(Nadkarni 1993).

PHYTOCHEMISTRY

The important phytochemical constituent of *Gymnema sylvestre* (Retz) Schult include oleanane class of triterpenoids called Gymnemic acid. The individual Gymnemic acid are Saponins, which includes Gymnemic acids i-vii Gymnemosides.(Sarasan 2008). Other constituents include formic, butyric and tartaric acid, flavones, anthraquinones, resins, -amyrin related glycosides and Stigmasterol.(Praveen & Murthy 2005).

PHARMACOLOGICAL USES

The plant shows a wide range of medicinal importance which has been briefly reviewed below.

- **ANTIDIABETIC PROPERTY**

Several studies revealed that the ant diabetic property of *Gymnema sylvestre* (Retz) Schultis due to stimulation of insulin release and by regeneration of Langerhans islets of pancreas. Other effects of the plant extract include a prolonged hypoglycaemic effect of exogenous insulin in dogs without pancreas (Okabayashi 1990). Treatment of 27 patients with IDDM who were on insulin therapy with *Gymnema sylvestre* (Retz) Schult leaf extract showed reduced plasma glucose levels at fasting and the requirement of exogenous insulin was also reduced drastically. Possibly it helps to regenerate the c-peptide ; an integral part of insulin tertiary structure (Kang et al 2012). Dihydroxygymnemictriacetate isolated from acetone leaf extract of *Gymnema sylvestre* (Retz) Schult was found to be a normoglycemic and hyolipidemic agent by increasing plasma glucose level (Baskaran et al 1990). An investigation on the patients receiving 200 mg of *Gymnema sylvestre* (Retz) Schult powder twice daily in addition to their normal doses of insulin, showed a significant decrease in mean glycosylated haemoglobin (HbA1C) from baseline to a normal level within six months (Krishna 2007).

- **TYPE II DIABETES RELATED COMPLICATIONS**

Nitric oxide is normally produced from L-arginine by Endothelial NO synthase (eNOS) in the blood vessels of Diabetic patients. Decreased production of NO by eNOS due to glucose overload, is a major cause for diabetic related vascular complications (Persaud 1999)..10 different compounds from the leaves of *Gymnema sylvestre* (Retz) Schult such as Gymnemic Acid, Gymnema Saponins i-v, gymnemagenin, Gymnemosides A and B deacylgymnemic acid have given positive responses with docked e-NOS enzymes using molecular docking (Ninomiya et al 1995). The binding energy of all these compounds were all very low that indicate that this compound has a good affinity for the enzyme e NOS acting as an agonist (Chatopadhyay et al 1993).

- **SWEET TASTE SUPPRESSION**

The sweet taste suppressing activity of *Gymnema sylvestre* (Retz) Schult. includes Gymnemic acids, Gymnema Saponins and Gurmarin (Ninomiya et al 1995). Gymnema Saponins completely inhibit the perception of sweetness by competing with receptor sites of taste buds. Gurmarin acts on the apical side of the taste cell by binding with the sweet taste receptor protein.(Reddy et al 2014).

- **ANTI-OBESITY PROPERTY**

One of the emerging epidemics of our country includes obesity. In general, elevated plasma level of resistin (Jaybhaye et al 2010), a cysteine rich residue secreted by the white adipose tissue, is a major cause behind obesity by causing insulin resistance. This resistin seems to be down regulated by Gymnemic acid. Currently, tea prepared from *Gymnema sylvestre* (Retz) Schult leaves is suggested by medical practitioners for curing obesity (Chakravarti et al 1996). It promotes the binding of carbohydrates to the receptor sites at the intestine and thus controls calories (Shigematsu et al 2001)

- **HYPOLIPIDEMIC ACTIVITY**

Alcoholic extract of *Gymnema sylvestre* (Retz) Schult leaves have shown to prevent atherosclerosis under in vitro conditions, the magnitude of which is equivalent to lipid lowering agent clofibrate (Asare-Anane 2009). An aqueous leaf extract of *Gymnema sylvestre* (Retz) Schult. lowers the accumulation of lipid in the liver of rats that were clinically administered high fat diet and also lowered the cholesterol in the circulating blood.(Abdul Bakrudeen et al 2006)

- **CHEMOTHERAPEUTIC ACTIVITY**

The methanolic extract of leaves of *Gymnema sylvestre* (Retz) Schult shows significant anti tumor activity. DMBA and croton oil induced tumor when treated with leaf extract of *Gymnema sylvestre* (Retz) Schult. showed a significant reduction in tumor incidence, tumor burden, and cumulative number of papillomas (Matthew 2014). The alcoholic extract of *Gymnema sylvestre* (Retz) Schult shows potent anti-cancer activity particularly in human lung carcinoma and human breast carcinoma(Krishna 2007.)

- **HAEMOLYTIC ACTIVITY**

Triterpenesaponins bearing polar substituents on the side rings causes lysis of the erythrocyte membrane and thus releases the haemoglobin. The first step involves an irreversible interaction of oligosaccharide side chain with erythrocyte membrane followed by glycosylation, thus destroying the membrane.(Kanetkar et al 2016)

- **ANTIMICROBIAL ACTIVITY**

The crude ethanolic extract of *Gymnema sylvestre* (Retz) Schult leaves shows excellent antibacterial activity against gram positive and gram negative bacteria like *Staphylococcus sp.* and *E.coli* The zone of inhibition in mm increased with the increased concentration of methanolic leaf extract (Chowdhury 2007)

- **ANTIOXIDANT ACTIVITY**

The invitro antioxidant activity of *Gymnema sylvestre* (Retz) Schult aqueous leaf extract against ascorbic acid as standard showed a promising result having a higher inhibitory effect as compared to that of ascorbate (Abdul et al 2009). This anti-oxidant activity was mainly due to the presence of flavonoids, phenols, tannins and triterpernoids. Reports are also there

that *Gymnema sylvestre* (Retz) Schult can increase the levels of super oxide dismutase, glutathione, and catalase. (Jain & Mudgal 1988).

- **ANTI-INFLAMMATORY ACTIVITY**

Aqueous leaf extract of *Gymnema sylvestre* (Retz) Schult shows an elevation of liver enzymes - glutamyl transpeptidases and super oxide dismutase protecting the human body against the activity of the free radicals. In rats, anti-inflammatory effect against paw oedema induced by carragenan. (Kishna et al 2010.) are known to be controlled by *Gymnema sylvestre* (Retz) Schult leaf extracts.

- **ANTIHelmintic PROPERTY**

Parasitic infection caused by the helminths have always been a topic of concern of human health care. The ethanolic leaf extract of *Gymnema sylvestre* (Retz) Schult have shown to exhibit significant antihelmintic property when tested on *Pheretima posthuma*. This is mainly due to the presence of polar and non polar groups present in the *Gymnema sylvestre* (Retz) Schult. leaves.(Sarasan, et al 2009)

IN-SITU CONSERVATIONAL STRATEGIES

Naturally *Gymnema sylvestre* (Retz) Schult is propagated through seeds but have a very low germination percentage owing to their short viability and scanty endosperm. In addition due to overexploitation of the plant, there is an urgency for its germplasm to be conserved (Reddy et al 2004). Due to indiscriminate collection practises their number in the natural habitat is decreasing day by day. They are fragmented in a very small sub population and are on the verge of being endangered (Chowdhury et al 1988)

- **MICROPROPAGATION**

MS medium containing BAP and NAA at 0.02mg/l resulted in shoot regeneration in maximum amount (Ninomiya et al 1993). However using 30 days old seedling axillary node explants incubated in MS medium supplemented with 0.01mg/l NAA, 1.0 mg/l BA, 100mg/l of citric acid resulted in a stunning 57.2% shoots to be induced. After hardening the shoots showed successful acclimatization.(Shrivastava et al 2011). However, the highest percentage of roots were reported to be induced in GS medium without any growth regulators. (Sharma et al 2010).

- **SOMATIC EMBRYOGENESIS**

Whole plant regeneration by somatic embryo formation has been achieved by callus obtained from hypocotyls, cotyledon and leaf explants from invitro raised seedlings of *Gymnema sylvestre* (Retz) Schult.(Sarasan et al 2006). MS medium containing 0.5-5.0 μ M of 2,4-D, 0.5-2.0 μ M of BA and 2% (w/v) of sucrose induced embryogenic callus within 6-8 weeks after culture initiation. In the medium, globular and heart shaped embryo were obtained. Further, this medium supplemented with MS salts, B₅ vitamins, BA and sucrose were added (Syedy et al 2014). The maturation of the embryos were found to be considerably influenced by the plant growth regulators and length of light and dark cycles. After transferring in the field the plantlets showed similar traits as that of the source plant (Pandey & Ashok 2012).

CONCLUSIONS

This article summarises the traditional and pharmaceutical uses of *Gymnema sylvestre* (Retz) Schult. belonging to the family Asclepiadaceae. This plant contains a large number of chemicals including triterpenoids all having medicinal

properties. Gymnemic acids present in the leaves are used as potent anti diabetic properties. But due to indiscriminate collection and unregulated trade, their number in natural habitat is decreasing day by day. Habitat loss and forest clearance is another threat to the species. So *insitu* conservation of the plant and sustainable harvesting may protect the plant to be available in the future.

REFERENCES

1. KM Nadkarni (1993) *Indian Material Medica*, Popular Prakashan Publisher, Bombay,
2. Sofowora A. (1996) Research on medicinal plants and traditional medicine in Africa. *J Altern Complement Med.* 54 8-14
3. DJ Chadwick and J Marsh (1994) *Ethnobotany and the search for new drugs.*,
4. Novartis Foundation Symposia, Wiley Online Library.
5. Das P.K. Mondal. A(2012) A report to the rare and endangered medicinal plants of the dry deciduous forests of PaschimMedinipore, West Bengal, *International Journal of Drug Discovery and Design* 2(2) 419-428.
6. S.K.Jain and A.Mudgal(1988) *Handbook of Ethnobotany*New Delhi Publisher
7. Katzmarzyk JL and Waist RR. Circumference and not body mass index explains obesity related health risk. *Am. J. Clin. Nutr.* 2004; 79 (3): 379 – 84.
8. Mukherjee P. Kand WahileA. “Integrated approaches towards drug development from Ayurveda and other Indian system of medicines,” *Journal of Ethnopharmacology*, vol. 103, no. 1, pp. 25–35, 2006.
9. V. Sarasas, R. Cripps, M. M. Ramsay et al (2006.), “Conservation in vitro of threatened plants-progress in the past decade,” *In Vitro Cellular and Developmental Biology—Plant*, vol. 42, no. 3, pp. 206–214,
10. Krishna I.Rother (2007) *Diabetes treatment –Bridging the divide* *N Engl J Med* 501-1499
11. Matthew Trendowski, (2014) Exploiting the cytoskeletal filaments of neoplastic cells to potentiate a novel therapeutic approach, *BiochimicaetBiophysicaActa (BBA) - Reviews on Cancer*,
12. Baskaran K, Kizar AB, Radha SK, Shanmugasundaram ER. (1990). Antidiabetic effect of a leaf extract from *Gymnemasylyvestre* in non-insulin-dependent diabetes mellitus patients. *J Ethnopharmacol* 30: 295–300.
13. Gupta SS. (1961). Inhibitory effect of *Gymnemasylyvestre* (*Gurmar*) on adrenaline-induced hyperglycemia in rats. *Indian J Med Sci* 15: 883–887
14. Okabayashi Y, Tani S, Fujisawa T et al. 1990. Effect of *Gymnemasylyvestre*, R.Br. on glucose homeostasis in rats. *Diab Res Clin Pract* 9: 143–148.
15. Kang, Lee, Choi et al Hypoglycemic activity of of*Gymnemasylyvestre* on oxidative stress and antioxidant status in diabetic rats.(2012) 24-60.
16. Reddy S, Gopal G, Sita G. In vitro multiplication of *Gymnemasylyvestre* R Br: An important medicinal plant. *CurrSci* 2004;10:1-4
17. Persaud SJ, Al-Majed H, Raman A, Jones PM. (1999). *Gymnemasylyvestre* stimulates insulin release in vitro by increased membrane permeability. *J Endocrinol* 163: 207–212.
18. Ninomiya Y and Imoto T: Gurmarin inhibition of sweet taste responses in mice. *American Journal of Physiology* 1995; 268(4)
19. Bishayee A and Chatterjee M: Hypolipidaemic and anti atherosclerotic effect of oral *Gymnemasylyvestre* (1994) R.Br. leaf extract in albino rats fed on a high-fat diet. *PhytotherapyRes* 8(2): 118-200.

20. Chatopadhyay RR, Medda C, Das S and Basu TK (1993;): Hypoglycemic and antihyperglycemic effect of *Gymnemasylvestre* leaf extract in rats. *Fitoterapia* 64: 450-544.
21. Praveen, N. MurthyH.N, Chung.M. (2011), Improvement of growth and gymnemic acid production by altering the macro elements concentration and nitrogen source supply in cell suspension cultures of *Gymnemasylvestre R. Br*, *Industrial Crops and Products*,33(2) 282-286
22. Jaybhaye and Deokule (2010) Study of Invitro seed germination and development of seedlings of *Gymnema sylvestre*.64-68
23. Rao MV and Kommalavali I,(2000) In vitro micropropagation of *Gymnemasylvestre* a multipurpose medicinal plants, *Plant Cell.Journal Plant Tissue Culture* 33 (2)97-105
24. VN.Naik (1999). *Flora of Marathwada*, AmrutPrakashan,
25. Chakravarti, KN,ChakravartiDS and ItlyMF1996). Crystalline saponin from *G Sylvester*, *Bulletin Scb. Trop med Calcutta*.
26. Kuzuko Y, Kayoko Shigenobu AA and Kouji M (1989). Structure studies of New anti sweet constituents from *G. sylvestris*, *tetrahedron, left*, 30 (9)
27. Shigematsu N. Asano R. Shimosaka M and Okazaki M.(2001) Effect of administration with the extract of *G. Sylvester R. Br*. Leaves on lipid metabolism in Rats. *Biol. Pharma.*; 24: 707 –712
28. Asare-Anane H, Al-Romaiyan A et al. 2009. Characterisation of the insulinotropic activity of an aqueous extract of *Gymnemasylvestre* in mouse -cells and human islets of Langerhans. *Cell PhysiolBiochem* 23: 124–132.
29. R Defronzo, E Ferrannini, H Keen, D Zimmet (2004) *International Textbook of Diabetes Mellitus*, 3rd edn. John Wiley & Sons Publications, Chichester
30. JE Sinsheimer, GS Rao (1970). Constituents from *Gymnemasylvestre* leaves. VI. Acylatedgenins of the gymnemic acids-isolated and preliminary characterization. *J Pharm Sci* 59: 629–632
31. Anu, K.I.; P.A. Nazeem; Lisamma Joseph and N.K. Vijayakumar(1994). Response of Gurmur (*Gymnemasylvestre R.Br.*) for invitro propagation. *South Indian Hort.*;42(6):365-68.
32. Abdul Bakrudeen Ali Ahmed, N. Komalavalli, M. Muthukumar, J.H.F. Benjamini, A.S. Rao& M.V. Rao, (2009). Pharmacological Activities, Phytochemical investigations and in vitro Studies of *Gymnemasylvestre R. Br*.A Historical Review. *Comprehensive Bioactive Natural Products, Chapter-3*, 75-99.
33. BP Choudhury (1988) Assessment and conservation of medicinal plants of Bhubaneswar and its neighbourhood. In: *Indigenous medicinal plants, Today and Tomorrow's Printers and Publishers*, New Delhi
34. Kanetkar P.V., R.S Singhal.,Laddha.K.S and Kamat.M.Y.(2006). Extraction and quantification of gymnemic acids through gymnemagenin from callus cultures of *Gymnemasylvestre*. *Phytochemical Analysis*, 17: 409-413.
35. Kanetkar, . P.V,Singhal.,R.S, K.S Laddha. and M.Y Kamat.(2006) Extraction and quantification of gymnemic acids through gymnemagenin from callus cultures of *Gymnemasylvestre*. *Phytochemical Analysis*, 17: 409-413.
36. Pandey&Ashok (2012) Cultivation technique of an important medicinal plant *Gymnemasylvestre R. Br*. (*Gurmar*). *Acad J Plant Sci*;5:84-90.
37. ShrivastavaR, PratibhaS (2011) In vitro propagation of multipurpose medicinal plant *Gymnemasylvestre R. Br.* (*Gudmar*). *Indian J ShodhaanusandhanSamachar* 2(1)27-30.
38. Sharma Y, Bharti S, Bansal.YK (2010) In vitro propagation of *Gymnemasylvestre Retz.* R. Br through apical bud culture. *J Med Plants Res* 333-337

39. SyedyMohsina, Nama KS. *Gymnemasylyvestre: a miracle fruit for a diabetes cure.* Int JPure ApplBiosci 2014;2:318-323
40. Singh, S. A. U. R. A. B. H., and MAYANGLAMBAM BILASHINI Devi. "Vegetables as a potential source of nutraceuticals and phytochemicals: A review." *Int J Med Pharm Sci* 5 (2015): 1-14.
41. Ayangla, N. W., N. E. E. T. U. Singh, and A. J. A. Y. Kumar. "Phytochemical analysis of plant species of genus *Zanthoxylum*." *International Journal of Medicine and Pharmaceutical Science* 6.1 (2016): 1-8.
42. Koula, D. O. U. K. A. N. I., G. A. C. E. M. Nacera, and B. E. N. L. A. R. B. I. Hayat. "Physicochemical and phytochemical characterization of some Algerian honeys types." *International Journal of Applied, Physical and Bio-Chemistry Research* 4.6 (2014): 1-16.
43. MEHTA, JYOTI, and AARA IFFET. "ANALYSIS OF PHYTOCHEMICALS, ANTIBACTERIAL AND ANTIOXIDANT ACTIVITIES OF CERTAIN MEDICINAL PLANTS OF GARHWAL AGAINST HUMAN PATHOGENS." *International Journal of Bio-Technology and Research (IJBTR)* 10 (2020): 49-62.



Figure 1; *Gymnemasylyvestre* (Retz) Schult

Table 1: Systematic Position of the Plant

Kingdom	Plantae
Subkingdom	Tracheobionta
Superdivision	Spermatophyte
Division	Magnoliophyta
Class	Magnoliopsida
Subclass	Asteridae
Order	Gentianales
Family	Asclepiadaceae
Genus	<i>Gymnema</i>
Species	<i>Sylvestre</i>

